UCRL-JC-121888 Abs

Shocked Quartz

W. J. Nellis and P. S. Fiske (Institute of Geophysics and Planetary Physics, Lawrence Livermore National Laboratory, Livermore, CA 94550; 510-422-7200, nellis1@llnl.gov)
M. Kikuchi and Y. Syono (Institute for Materials Research, Tohoku University, Katahira 2-1-1, Aoba-ku, Sendai, JAPAN)
Z. Xu (Department of Geological and Environmental Sciences, Stanford University, Stanford, CA 94305-2115)

Bob McQueen studied quartz extensively at high shock pressures using fast optical diagnostics. We report properties of single-crystal quartz shocked and recovered from pressures in the range 20-57 GPa (200-570 kbar). Our samples span the transition region (20-40 GPa) and the high-pressure amorphous phase. To investigate effects of pulse shape on loading and of strain on release, both steel and Al sample capsules were used with a 6.5 m-long two-stage gun.

Samples (1.2 cc) were recovered from 20-38 GPa in steel capsules. XRD shows increasing quartz line broadening up to 31 GPa and substantial amorphous material at 38 GPa. ^{29}Si NMR spectra show line broadening and a shift with pressure. Above 30 GPa the spectra have two components, one caused by defected quartz and one by amorphous SiO_2. The sample shocked to 28 GPa shows an additional small peak typical of stishovite. These data show that quartz transforms continuously to glass. It appears that a small amount of stishovite may be formed near 28 GPa but back transforms to silica at higher shock pressures and temperatures.

Samples (0.08 cc) shocked in Al at 43-57 GPa consist of amorphous SiO_2 grains separated by a network of radial and concentric dark veins filled with silica and nanocrystalline Al and Si. The veins are analogous to type A pseudotachylites found in large meteorite impact structures. They are evidence for meteorite impact and indicate zones of central uplifts or basin-bounding rings. We observe pseudotachylite-like veins because the Al capsule has a good shock impedance match to quartz, which causes a nearly single wave on shock loading, as in a natural impact. Al also permits a relatively large strain on release of pressure, as in a natural impact.

This work was performed at Lawrence Livermore National Laboratory under the auspices of the U.S. Department of Energy under contract No. W-7405-Eng-48.

1. 1995 Fall Meeting

2. 03649995

3a. W. J. Nellis
L-299
Lawrence Livermore Lab
Livermore, CA 94550

3b. Tel: (510) 422-7200

3c. Fax: (510) 422-2851

3d. nellis1@.llnl.gov

4. T

5a. T08. Earth Materials at Extremes of Pressure and Temperature: A Session in Honor of Robert McQueen

5b. 5415 Cratering
3944 Shock Wave Exps
3924 High-P Behavior

5c.

6.

7. 30%

8.

9. I. Tom Shankland

10.

11. No